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1 16. Fish Passage Restoration

This technique addresses the restoration of fish passage in streams and rivers. The WDFW has authored several documents directly related to this topic. As such, the reader is encouraged to refer to these documents for a comprehensive presentation of design and implementation guidelines relative to fish passage. These documents are:

- WDFW, 1999. Fish Passage Design at Road Culverts (http://www.wa.gov/wdfw/hab/engineer/cm/toc.htm)
- WDFW, 2000. Fishway Guidelines for Washington State
- WDFW, 2000. Fish Protection Screen Guidelines for Washington State

Technical Assistance on Fish Passage Issues is available from the WDFW on the Internet at http://www.wa.gov/wdfw/hab/engineer/habeng.htm. The reader is also encouraged to review the Proceedings of the International Conference on Environment and Transportation (ICOET).

1.1 Introduction

1.1.1 Description of Technique

For migratory species of fish and wildlife, successful completion of their life cycle hinges on access to required habitats and safe, effective passage between these habitats. Connectivity between fish and wildlife spawning, rearing, and overwintering habitats is critical to the survival and persistence of the robust populations. Man imposed physical barriers (ex. improperly designed culverts) impede passage and reduce connectivity by fragmenting habitat. More pronounced structures such as dams constrain passage and may entrain or impinge fish within inlet / intake structures.

This technique focuses on restoring upstream and downstream passage of fish at locations where land use and construction activities have imposed a passage constraint. The majority of fish passage problems occur in association with roads at water crossings and flow control structures such as dams. The Washington Department of Fish and Wildlife estimates that there are 2,400 blocked culverts in the state, which effectively eliminate over 3,000 miles of stream habitat (Washington Department of Fish and Wildlife, 1995). More recent studies indicate this is an underestimate of the problem and that an average of 80% of all culverts in the Puget Sound basin block fish passage (Washington Trout, unpublished data). Problems with blocked culverts and misidentification or failure to identify fish bearing streams are causing serious habitat problems for fish.

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In many of these instances, effective upstream and downstream passage is achieved simultaneously, provided that proper design and implementation and maintenance occurs. Upstream and downstream fish passage at dams and large irrigation diversions is much more complex and typically requires construction of formal fishways and fish protection screens. Discussion of this type of structure is out of the scope of this document. The reader is encouraged to review the Fishway Guidelines for Washington State (WDFW 2000) and Fish Protection Guidelines for Washington State (WDFW 2000).

Fish passage at road crossings is addressed under Washington State Law (WAC 220-110-070) which states:

> *In fish bearing waters, bridges are preferred as water crossing structures by the department in order to ensure free and unimpeded fish passage for adult and juvenile fishes and preserve spawning and rearing habitat. Pier placement waterward of the ordinary high water line shall be avoided, where practicable. Other structures which may be approved, in descending order of preference, include: Temporary culverts, bottomless arch culverts, arch culverts, and round culverts. Corrugated metal culverts are generally preferred over smooth surfaced culverts. Culvert baffles and downstream control weirs are discouraged except to correct fish passage problems at existing structures.*
>
> *A Hydraulic Project Application is required for construction or structural work associated with any bridge structure waterward of or across the ordinary high water line of state waters. An HPA is also required for bridge painting and other maintenance where there is potential for wastage of paint, sandblasting material, sediments, or bridge parts into the water, or where the work, including equipment operation, occurs waterward of the ordinary high water line. Exemptions/5-year permits will be considered if an applicant submits a plan to adhere to practices that meet or exceed the provisions otherwise required by the department.*
>
> *Water crossing structure projects shall incorporate mitigation measures as necessary to achieve no-net-loss of productive capacity of fish and shellfish habitat.*

This technique discusses the physical, hydraulic, and biological considerations required in addressing and restoring fish passage. Effective flow conveyance and fish passage both rely on the proper combination of physical and hydraulic parameters necessary to meet the desired objective. These parameters include slope, channel geometry, roughness, water depth, velocity, turbulence, and energy dissipation.

1.1.2 Physical and Biological Effects

The physical effects associated with fish passage projects may include localizes changes in sediment transport processes (short term) or the hydraulic conditions of a reach by altering slope and/or channel

shape. These physical changes directly impact the aquatic environment by altering habitat characteristics that effect fish use and behavior. Providing access to upstream habitats, particularly for migratory fishes is essential. In Washington, the following migratory species rely on unimpeded access to and from habitats available in upper watersheds.

Table 1. Migratory fish species in Washington

Anadromous	
	Steelhead
	Coho, chinook, pink, chum, sockeye salmon
	Cutthroat trout
	Pacific lamprey
Non-anadromous	
	Juvenile coho, chinook, and steelhead
	Kokanee
	Rainbow and Cutthroat trout
	Brown and brook trout
	Bull trout / Dolly Varden
	Mud minnow
	Stickleback
	Sculpin
	Pygmy and Mountain whitefish
	Minnows
	Pacific Lamprey
	Suckers
	Nooksack dace
	Sturgeon (adult and juvenile)

The need for unimpeded access to required habitats varies with lifestage. Fry and fingerlings need to freely disperse to reduce competition and spread risk of mortality. Fry and fingerlings strive for optimal rearing conditions (e.g. reduced competition, good quality and quantity of water, good habitat, food and fewer predators) to ensure their survival. Access is not limited to within the mainstem environment, especially for fry, as they often move laterally out of rivers and into tributaries and side channels. During smolt migration to the ocean, downstream passage must be efficient physically and without delay. Adults must be allowed to freely distribute within suitable habitat and have unconstrained access to spawning areas. Again timing is important during adult spawning migrations.

While salmonids are often emphasized in fish passage projects, many species of amphibians, reptiles and mammals also use stream corridors for migration and as daily movement corridors. Culverted streams under roads pose substantial barriers to such passage and have been the subject of numerous

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experimental and more developed designs to accommodate terrestrial wildlife as well as fish passage along culverted streams.

NOTE – THIS TECHNIQUE ENDS HERE.

1.2 Examples

Picnic Point creek, WA
Small scale pivate dam and fishway – Waddel Creek Tributary
Stream simulation culvert
Screen installation

1.3 References

WDFW, 1999. Fish Passage Design at Road Culverts
(http://www.wa.gov/wdfw/hab/engineer/cm/toc.htm)

WDFW, 2000. Fishway Design Guidelines for Washington State

WDFW, 2000. Fish Protection Screen Guidelines for Washington State

1.4 Photo and Drawing File Names

No Photos yet – Ken Bates probably has many

Drawings from WDFW Fish Passage Design Manual
Photo of Waddel Creek Tributary – Dam/Fishway – Example of small fishway which provides passage for adult and juvenile fish. (Glenn Hird has electronic drawings, I have photos)

Photo of stream simulation culvert (Bob Barnard)

Photo of screen facility (Eric Egbers or Bob Gowen)

Peter Skidmore to provide photos of Picnic Point Creek fish passage project